BRIEFER ARTICLES

ORIGIN OF THE THALLUS, ALTERNATION OF GENERATIONS, AND THE PHYLOGENY OF CUTLERIA.[1]

THE Cutleriaceæ (Cutleria and Zanardinia) may be considered among the most interesting and remarkable forms of the Phaeosporeae.

The two fronds, sexual and asexual, of the single species of Zanardinia (*Z. collaris*) are identical. The genus Cutleria, represented in Europe by two species, has a sexual thallus whose structure and development is very different from the asexual form. The oogonia and antheridia are borne upon the plant named Cutleria, whose thallus is composed of and formed through the union of marginal filaments remaining free upon the periphery, and becoming divided by partitions with the thickening of the thallus following the fusion. So the thallus is both a pseudoparenchyma and a true parenchyma.

The sporangia are borne in the upper surface of Aglaozonia, which has a creeping habit, and grows by marginal cell division like Zonaria. It now seems to be established that *Aglaozonia parvula* is the asexual form of *Cutleria multifida*, and one may suppose with Falkenberg that *A. chilosa* is the asexual form of *C. adspersa*. In reality, however, this supposition rests upon the fact that we do not know in Europe any other species of Cutleria or Aglaozonia.

But I have found at several points on the coast of the gulf of Gascony a new Aglaozonia, the *Zonaria melanoidea* of Schousboe, discovered at the beginning of the century at Maroc, and not reported since, whose Aglaozonia nature has remained unrecognized. For various reasons I consider *Aglaozonia melanoidea* to be the sporophyte of *C. adspersa*. If that form has not been seen up to the present in the Mediterranean where *C. adspersa* is not rare, it is without doubt because of its very great resemblance to Ralfsia. But since we do not know the gametophyte of *A. chilosa*, and as the Cutlerias are plants with a rather large thallus, conspicuous and easily recognized, it is

[1] This contribution is in part a résumé by PROFESSOR SAUVAGEAU of his paper entitled "Les Cutleriaceæ et leur Alternance de Générations," Ann. d. Sci. Nat., Bot. 10: 265. 1899. Translated by Dr. Bradley M. Davis.

improbable that the Mediterranean hides a third species of Cutleria. Therefore *A. chilosa* multiplies always non-sexually, without alternation of generation, as is also the fact with *A. parvula* in northern Europe. If it possesses a gametophyte it is without doubt some exotic species (*C. compressa*, *C. pacifica*) as yet insufficiently studied.

As for the culture of oospheres of Cutleria, it has given up to the present very conflicting results. Thus in the middle of the century Thuret obtained through the germination of parthenogenetic oospheres some small plants somewhat resembling an Ectocarpus, which no one has since found, and which I call form *Thuretiana* of germination. But Falkenberg has obtained from the germination of fertilized oospheres (the only ones that did germinate in his cultures) some strange plants, at first with the form of a small upright column, at the base of which is borne, after it has arisen, a creeping plate comparable to Aglaozonia; these plants I call form *Falkenbergiana*. There is also a form *Falkenbergiana* that has been obtained by Church, but from the germination of parthenogenetic oospheres, in this respect differing from the results of Thuret and Falkenberg. Finally the zoospores of *A. parvula* have given to Church plants which, like the preceding, have the creeping plate-like thallus of Aglaozonia, but whose column ends at the summit in filaments (not fascicled) which bear the reproductive organs of Cutleria. I have named this new example of germination form *Churchiana*. Some plants comparable to these have developed in the cultures of Kuckuck.

How shall such divergent results be reconciled? It may always be borne in mind that the preceding authors have never obtained uniformity of germination in their cultures.

Now I have found *C. adspersa* at Guéthary (Basses-Pyrénées) when the male plants were more numerous than the female. The discharge of the sexual elements was abundant, and took place readily in my cultures. However, I have never obtained fertilization; the oospheres did not even attract the antherozoids. At times they germinated very readily parthenogenetically and gave always and characteristically the form *Falkenbergiana*. This is in agreement with the observations of Church, but my results are the more surprising, for the English author found only a few or no male plants; his female plants were therefore unfortunately parthenogenetic.

It occurred to me to look for germination of spores in nature upon the Cutleria plants themselves. I have found a great many of the

sporelings *Thuretiana* and *Falkenbergiana* and rarely some *Churchiana*. One finds all the intermediate conditions between very young *Thuretiana* in the form of a simple filament, and young Cutleria fascicled or with free filaments at the margin; consequently the form *Thuretiana* gives rise to the thallus of Cutleria, and is not an abnormality of the cultures as Falkenberg believed. The sporelings *Falkenbergiana* were truly thalloid, and I have shown that the column takes on a larger thallus than would be supposed from the cultures of the preceding authors. I was able to follow sufficiently far the development of the creeping Aglaozonia-like plate whose structure resembles that of *A. melanoidea*.

This is, therefore, the first time that these plants have been found united, but what of their origin? They cannot be attributed to the zoospores of *A. melanoidea*, for during all the time of my observations these plants remained sterile. Since the parthenogenetic oospheres in my cultures of Cutleria gave on germination form *Falkenbergiana*, it is to be supposed that identical plants found in nature in the same locality and at the same time would have the same origin. And since in this situation the male individuals are more numerous than the female, one may admit the antherozoids should play a part, and that fertilization, although not operative in my cultures, occurs in nature, and consequently that the form *Thuretiana* owes its development to fertilized oospheres. As for the form *Churchiana*, that is an anomaly, an example of *Falkenbergiana* with the column changed at the tip into Cutleria; it is interesting in the same manner as a flower of some phanerogam with metamorphosed petals and stamens.

If the results obtained by previous authors are reconciled, we must acknowledge from these conclusions that alternation of generations is not necessary, but rather, as one may say, facultative. Moreover, an oosphere of Cutleria, whether it be parthenogenetic or fertilized, may give on germination either Cutleria or Aglaozonia. Similarly, a zoospore of Aglaozonia may produce Cutleria or Aglaozonia. But we do not know the conditions that govern the development from the zoospores or oospheres in either case.

As for the affinities of Cutleria, they are numerous. The sexual thallus (Cutleria proper) has a method of development that is found in the Sporachnaceæ; it bears oogonia and antheridia similar to those of Sphacelariaceæ and Tilopterideæ. The asexual thallus (Aglaozonia) recalls certain of the Sphacelariaceæ (Battersia, *Sphacelaria olivacea*) and certain of the Dictyotaceæ (Zonaria, Padina).

But Aglaozonia is not a direct product of germination; it is a secondary product, always formed from a pro-embryo or small column. Now the column produces normally at its base the creeping thallus of Aglaozonia, and abnormally at its tip a frond of Cutleria (form *Churchiana*). Here are the extremes, Cutleria and Aglaozonia, but the column has a place between, although its structure differs clearly from both. It appears to us to be a necessary and fundamental organ, probably of great importance phylogenetically. In its structure the column resembles greatly those of Myriotrichia and Litosiphon; it is possible that in teratological conditions it forms reproductive organs, which knowledge would throw strong light upon its affinities. I consider Cutleria, therefore, as a union of three genera, Cutleria proper, Aglaozonia, and the column of some unknown genus.—C. SAUVAGEAU, *University of Dijon, France.*

SOME PLANTS OF NEW MEXICO.

CASTILLEIA CONFUSA × ACUMINATA, n. hyb.—Leaves variable, some just as in *C. acuminata*, others on the same plants very narrow, almost linear, as in *C. confusa;* bracts with lateral narrow lobes 3 to 4^{mm} long in the dried plant (1–1.5^{mm} in *acuminata*, at least 4^{mm} in *confusa*); apical parts of bracts delicately tinted with pink (yellow in *acuminata*, bright red in *confusa*); galea 6^{mm} (8^{mm} in *confusa*, hardly 5^{mm} in *acuminata*); plant rather rougher than *acuminata*.

Harvey's Ranch, near Las Vegas, New Mexico, 9600^{ft}, August 22, 1899. (*Wilmatte Porter* and *T. D. A. Cockerell*). This is clearly a hybrid, and was found growing in a meadow along with quantities of *C. confusa* Greene, and *C. acuminata* (Pursh).

SIDALCEA CANDIDA **tincta**, n. var.—Similar to *S. candida*, but petals suffused with pink toward their ends; anthers before dehiscence bright pink; on dehiscence turning black; pollen white; petals barely emarginate, 12^{mm} long, 10.5 broad; calyx lobes broad at base, narrow at apex, pointed, about 6^{mm} long and 3^{mm} broad at base; cauline leaves a rather light bright green, palmately 5 to 7-parted, or cleft nearly to the base, the divisions about 60^{mm} long and 17^{mm} broad, on the upper leaves entire, on the lower 2 or 3-cleft at the ends; stem light green, shining, glabrous; calyx and peduncles rough and more or less hairy; carpels 8, smooth when ripe, with an upright hairy beak.